IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I, JUDITH MARGARET ATKINSON, B.A., M.I.T.I. declare

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2. That I am well acquainted with the French and English languages.
3. That the attached is a true translation into the English language of International Patent Application No. PCT/FR2004/001922.
4. That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardise the validity of the patent application in the United States of America or any patent issuing thereon.

Declared this 7th day of December 2005

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HEALD FRAME AND WEAVING MACHINE PROVIDED WITH AT LEAST ONE SAID FRAME

The present invention relates to a heald frame, and to a weaving machine equipped with such a frame.

It is known to equip a weaving machine with heald frames which are to be driven in a vertically oscillating movement by means of an appropriate device, such as a heald loom or a dobby. To that end, each heald frame is produced by the reversible assembly of two posts and two cross-members, the posts being substantially vertical when the heald frame is in the use configuration, while the cross-members are substantially horizontal.

The mutual fixing of each post and of each cross-member is described especially in FR-A-2 542 332.

According to the teaching of that document, each cross-member is hollowed out, at its two ends, to form a corresponding recess in which a protrusion of the post is received. In addition, the protrusion is retained in the recess by the action of a clamping screw cooperating with a threaded block that is integral with the cross-member.

However, this known solution has some disadvantages.

The presence of the recess in the cross-member results in the formation of two thin front walls bordering the recess. Those thin portions, which work in traction, do not have sufficient strength, given their small thickness.

It would, of course, be possible to compensate for this mechanical weakness by reinforcing the above-mentioned thin walls. However, this would render the cross-member as a whole much heavier.

The problems identified above are increasingly crucial in so far as it is desired to operate weaving machines at increasingly high speeds, which involves making the heald frames as light as possible in order to reduce their inertia, thus reducing the mechanical strength of the cross-members. By contrast, the mechanical connections between the post and the cross-members must be increasingly strong in order to withstand the increasingly violent accelerations and decelerations to which those movable parts are subjected.

In the light of the above, the invention aims to remedy the disadvantages of the known devices by proposing a strong heald frame that is capable of being mounted on a machine operating at high speed.

To that end, it relates to a heald frame for a weaving machine, said frame comprising two posts and two cross-members, each of which is equipped with a heald-carrying bar, while there are provided means for fixing at least one post relative to at least one corresponding cross-member, the fixing means comprising a protrusion from the post, which protrusion is suitable for being received at least partly in a recess formed in the cross-member, and also means for the mutual retention of the post and the cross-member, wherein said fixing means further comprise an intermediate tubular fixing element accommodated in an

indentation formed in the cross-member, the tubular element defining an internal volume which forms said recess for receiving at least part of said protrusion, while there are provided means for the mutual connection of the tubular fixing element and the cross-member.

The invention relates also to a weaving machine equipped with at least one heald frame as defined above.

The invention will be better understood, and other advantages thereof will become more clearly apparent, in the light of the description which will be given hereinbelow of a weaving machine and of a heald frame in accordance with the principle of the invention, which description is given solely by way of non-limiting example and with reference to the accompanying drawings, in which:

- Figure 1 is a diagrammatic view of a weaving machine according to the invention;
- Figure 2 is a partial longitudinal section showing a heald frame of the machine of Figure 1, in the region of the ends of one of its posts and one of its cross-members, respectively; and
- Figure 3 is a section according to line III-III in Figure 2.

In Figure 1, a dobby 1 is intended to move a heald frame 2 of a weaving machine M, according to a vertically oscillating movement represented by the arrows F_1 and F'_1. To that end, a driving arm 1a of the dobby 1 is coupled to each heald frame by way of rods and oscillating levers.

Each frame 2 comprises an assembly of two posts 4, 4' and two cross-members 6, 6'. The posts extend generally in a direction parallel to the direction of vertical oscillation Z-Z' of the frames 2, while the cross-members extend generally in a direction Y-Y' perpendicular to the direction Z-Z' and generally horizontal during operation of the machine M.

In the present description which follows, the connection between the left-hand post 4 and the upper cross-member 6 of a frame 2 will be studied in greater detail. It will be understood that the assembly of that cross-member 6 with the right-hand post 4', or the assembly of the lower cross-member 6' with one or other of the posts 4, 4', can incorporate the same structural and functional characteristics.

Referring more particularly to Figures 2 and 3, 6_1 denotes the principal end of the cross-member 6, corresponding to its major dimension or length. 6_2 denotes the front faces of the cross-member 6, which thus extend, during operation, facing other cross-members. Finally, 6_3 and $6'_3$ denote the side walls of the cross-member 6.

One of the side walls, $6'_3$, in this case the lower side wall, is prolonged in a known manner by a foot 8 which forms a heald-carrying bar to which healds 10 for guiding the warp threads of the machine M can be attached. In this respect, the lower cross-member 6' is likewise provided with another heald-carrying bar (not shown).

The cross-member 6 is hollowed out to form an indentation 12 which opens in the region of the principal end 6_1 of the cross-member. The indentation 12 also opens at the front faces 6_2, that is to say extends over the entire thickness of the cross-member.

By contrast, the indentation does not extend over the whole of the height of the cross-member, that is to say does not open in the region of the side walls 6_3, $6'_3$ thereof. Consequently, the indentation 12 is bordered by lateral end tabs, denoted 6_4 and $6'_4$.

A hollow sleeve 14 forming an intermediate tubular fixing element between the cross-member and the post is received in the above-mentioned indentation 12. The sleeve 14, which is produced, for example, from a tubular member which has been cut to the appropriate size, has side walls which, in transverse section, generally form a rectangle.

14_{21} denotes the long sides of the rectangle, and 14_{22} denotes the short sides thereof. As is shown especially in Figure 3, the front dimension, or thickness E, of the sleeve 14 is greater than the front dimension, or thickness $\underline{e}$, of the cross-member 6. However, it is possible for the thickness E to be less than or equal to the thickness $\underline{e}$ of the cross-member.

The hollow sleeve 14 defines an internal volume V in which a protrusion of the post 4 can be received, as will be seen hereinbelow. The protrusion can be introduced into the internal volume V, which forms a receiving recess,

through an opening 14_3 allowing access to the inside of the sleeve.

As is shown especially in Figure 2, the side walls of the hollow sleeve 14 are prolonged by an integral base denoted 14_1. The base 14_1, which is provided on the opposite side from the above-mentioned opening 14_3, imparts satisfactory strength to the sleeve 14 while forming a barrier to the fixing adhesive, in order to isolate the internal volume of the sleeve.

There are additionally provided means for fixing the sleeve relative to the cross-member 6. In the present case, the short sides 14_{22} are adhesively bonded to the facing walls of the tabs 6_4 and $6'_4$ bordering the indentation 12. As is shown especially in Figure 3, the side walls 14_{21} and 14_{22} of the sleeve 14 are prolonged by extensions 15 and 15' which extend from the upper right-hand and lower right-hand angles, respectively, of the rectangle formed by the side walls in transverse section.

More precisely, each extension 15, 15' first of all comprises a vertical foot 15_1, $15'_1$ as well as an end return portion 15_2, $15'_2$, which extends horizontally. The feet and the return portions, which are adhesively bonded to the facing walls of the cross-member, allow the surface area for adhesive bonding between the sleeve 14 and the cross-member 6 to be increased, which ensures a particularly reliable connection between the sleeve and the cross-member.

The sleeve 14 is advantageously made of a metal having high mechanical strength, for example stainless steel. By way of variation, it may be made of a light metal alloy, such as aluminium, in so far as its side walls 14_{21} can be made thicker, and therefore stronger, than the side walls of the cross-member.

Figures 2 and 3 also show a resilient plate 16 which is fixed by screwing, at a first end 16_1, to the free end of the upper tab 6_4. The resilient plate 16, which penetrates into the internal volume V of the sleeve 14, has a bent limb 16_2 which is prolonged by a U-shaped end return portion 16_3. The core 16_{31} of the return portion 16_3 extends in the vicinity of the principal portion of the resilient plate 16, which is itself in contact with the stud 4_1.

Away from its free end, the upper tab 6_4 receives a screw 18 which penetrates into a threaded block 20, forming a nut, which is accommodated in the sleeve. The block 20, which is held in position laterally by the wings 16_{32} of the U-shaped return portion 16_3, bears against the wall 14_{22} of the sleeve 14.

Finally, the post 4 is provided with a protrusion 4_1, forming a stud, which is intended to penetrate into the internal volume V of the sleeve 14. The stud 4_1 has a flat front face 4_2 which extends, during operation, in the vicinity of the end of the sleeve 14 remote from the access opening 14_3.

The stud 4_1 also has a first side wall 4_3 which is provided with a notched portion 4_4 intended to cooperate with the

bent limb 16_2. The other side wall 4_5 of the stud 4_1 has two flat surfaces 4_6 for bearing on the opposing short side 14_{22} with which the sleeve 14 is provided.

The side wall 4_5 also defines two curved surfaces 4_7, the concavity of which is turned towards the inside of the sleeve 14. In that manner, the side wall 4_5 bears on the sleeve only partly, owing to the presence of the curved surfaces 4_7 extending at a distance from the sleeve.

When the stud 4_1 is introduced into the internal volume V of the sleeve 14, through the opening 14_3, the bent limb 16_2 of the plate 16 penetrates into the notched portion 4_4 of the stud 4_1, ensuring the indexation thereof relative to the cross-member 6. It is to be noted that this phenomenon can readily be perceived by the operator, who accordingly has information regarding the correct positioning of the post 4 relative to the cross-member 6. It is then a question of mutually retaining those two elements by urging the screw 18 against the resilient plate 16 and, consequently, against the side wall 4_3 of the stud 4_1.

It is to be noted that the two flat surfaces 4_6 and the screw 18 are offset relative to one another. This accordingly contributes to a satisfactory distribution of the forces to which the stud 4_1 is subjected, given that the moments exerted by the surfaces 4_6 and by the screw 18 are located at different locations on the stud 4_1.

The invention has been represented by means of a particular type of mechanical device for the assembly of a post and a cross-member. It is applicable by means of

other mechanisms, regardless of their exact type, and, in particular, by means of mechanisms of resilient and non-resilient connection which have the effect of inducing high stresses in the vertical walls or long sides of the cross-members.

By way of variation, it is possible for only one end of a post and/or of a cross-member to be produced in accordance with the invention, as described above. In this respect, the other end is the subject of a different type of fixing, using especially a non-removable connection.

The invention is applicable regardless of the material used for the parts constituting the frames. It is applicable especially to frames of a light metal alloy, such as aluminium, as well as to frames made of composite materials comprising an organic resin and reinforcing carbon or glass fibres.

The invention is applicable regardless of the geometry of the heald-carrying bars with which the cross-members are equipped, which may accordingly have different forms adapted to those of the ends of the healds.

The invention allows the objectives mentioned above to be achieved.

Retention of the stud of the post is achieved in principle by way of the fixing sleeve, which is capable of withstanding very high forces. The cross-member, on the other hand, is substantially not subjected to any stress due to such retention. Accordingly, the invention provides

separation of functions, using an intermediate element that is more specifically dedicated to the mutual fixing of the cross-member and the post.

Moreover, the existence of two lateral tabs of the cross-member, bordering the receiving recess of the sleeve, is advantageous. It means that the mechanical characteristics of the cross-member do not have to be altered substantially, because the strong parts thereof are kept virtually in their totality.

Furthermore, in the case where the receiving indentation of the sleeve opens at the front faces of the cross-member, this allows the sleeve to be given a maximum width. In this case, the stud can then have a greater thickness and, consequently, good mechanical strength properties.

In addition, thanks to the invention, machining of the cross-member is simple and rapid. Finally, the mutual connection of the fixing sleeve and the cross-member is simple to carry out.